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THE DYING OF PINE IN THE SOUTHERN STATES: CAUSE, EXTENT, AND REMEDY.

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., October 3, 1911.

Sir: I have the honor to transmit herewith for publication a paper dealing with the Dying of Pine in the Southern States—Cause, Extent, and Remedy. It consists of a series of revised circular letters which have been used during the present year in an active campaign by this bureau through a forest-insect field station located at Spartanburg, S. C., the purpose of which has been to study the character and extent of the dying pine and to give instructions and demonstrations to the owners within the worst affected areas on the most economical and effectual means of control.

The known destructive habits of the southern pine beetle, which is the cause of the trouble, and the threatening character of the present outbreak render its immediate control of the greatest importance to the people of the South Atlantic and Gulf States. It is perfectly capable of killing a large percentage of the young and matured trees of the pine forests of the entire South, as it did in West Virginia and Virginia in 1890 to 1893.

The paper gives the essential facts relating to the insect, its work, practical methods of control, and how to protect the pine from its depredations in the future.

It is absolutely necessary that the owners of farmers' woodlots, as well as the individual and organized owners of large areas of growing and matured pine, should be familiar with the essential requirements of locating and disposing of the infested timber in order to meet with success in any effort to control it. Therefore, I recommend the publication of this paper as a Farmers' Bulletin.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE DYING OF PINE IN THE SOUTHERN STATES: CAUSE, EXTENT, AND REMEDY.

During the past few years the dying of pine in the southern Atlantic and Gulf States, from Maryland to Texas, inclusive, has attracted attention and has been the subject of special investigation and extensive correspondence.

CAUSE OF THE DYING OF PINE.

In the areas designated as the shortleaf pine and loblolly pine belts, as well as in parts of the longleaf pine belt, the death of the pine has been caused by the southern pine beetle, while in Florida and certain other sections it is apparently due to a combination of other but similar bark-boring beetles.

THE SOUTHERN PINE BEETLE.

The southern pine beetle was described in 1868 under the technical name *Dendroctonus frontalis* from specimens collected in North Carolina or South Carolina.

It is a small brownish or black beetle, somewhat smaller than a grain of rice. It flies in March to December in the more southern sections, and from May to November in its northern range. It attacks the middle to upper portions of the trunks of healthy pine and spruce trees, causing their death by excavating long, winding burrows or egg galleries (figs. 1, 3), which extend through the inner layers of the living bark and mark the surface of the wood (fig. 2). Eggs are deposited along the sides of these galleries, from which young grubs (larvæ) hatch and then feed on the inner bark until they have attained the size of the parent beetles, when they mine into the outer bark and transform to the dormant (pupal) stage, and later to the adult or beetle stage. The beetles then emerge to fly in search of other living trees in which this process of attack and development is repeated.

The winter is passed in the bark of the living and dying trees in all stages of development. The more advanced individuals begin to emerge and fly in March to May and the remainder continue to develop and emerge until about the last of July, so that by this time all of the trees that were attacked during the previous fall and early winter are completely dead and abandoned by the beetles.

There are from three to five generations annually. The first generation begins with the eggs deposited by the first beetles that fly and attack the trees in the spring and by those of the overwintered broods as they make successive attacks during the spring and early summer.

The second generation begins with the eggs deposited by the adults of the first generation and so on until cold weather stops their activities.

At all times there is a more or less complex overlapping of generations, so that there is a continuous emergence and attack during

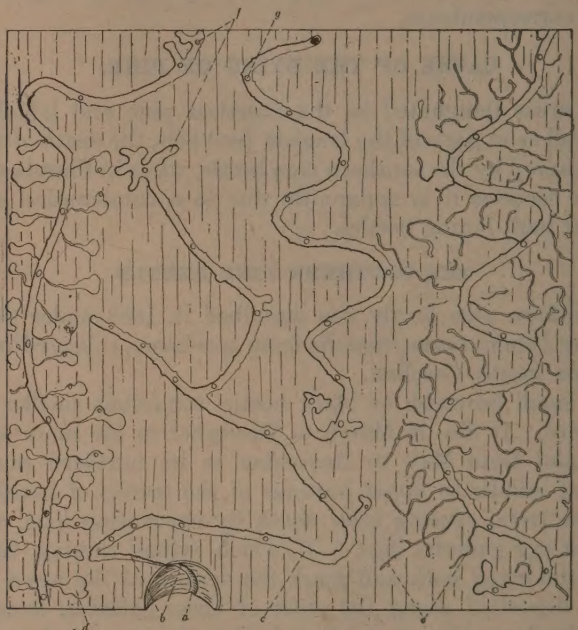

FIG. 1.—Egg galleries and larval mines of the southern pine beetle: *a*, Entrance; *b*, entrance burrow; *c*, egg gallery; *d*, normal larval mine; *e*, abnormal larval mine; *f*, terminal; *g*, ventilating burrows. Slightly reduced. (Author's illustration.)

the entire period of activity; consequently a continuous dying of trees within the infested areas.

Under average or normal conditions of the activities of this beetle a few scattering trees are killed by it each year in nearly every county throughout the Southern States where the pine is common. If, however, there are from any cause favorable conditions for the multiplication of the insect, it is thus able to kill groups of trees, and if these groups increase in number and size the following year they constitute the danger signal of an outbreak which may result in widespread depredations. Therefore it is a most destructive enemy

of the pine within its range—in fact, it is, as has been frequently stated during the past 10 years, a constant menace to the living pine of all of the Southern States, from Maryland to Missouri and southward to the Gulf of Mexico. (See fig. 4.)

Evidence of the Destructive Work of the Beetle.

The presence of this beetle in dangerous or destructive numbers is plainly indicated by patches of dying and dead pine which show no evidence of injury by fire or other destructive agencies.

The trees infested by the developing broods are indicated by the fading green, greenish brown, and yellowish red of the foliage, and positively determined by the removal of some bark from the *middle* of the trunks of a few of the dying trees and the finding of the characteristic work in the inner bark and on the surface of the wood, as shown in figures 2 and 3.

The trees which have been killed and abandoned by the developed broods of the beetles are indicated by the reddish-brown foliage (abandoned red tops), the fallen foliage (abandoned black tops), and the decaying standing or fallen trees (abandoned broken tops and snags, fallen trees, etc.). The cause of the death of trees of any of these stages is determined by examining the dead bark for evidence of the work of the beetle.

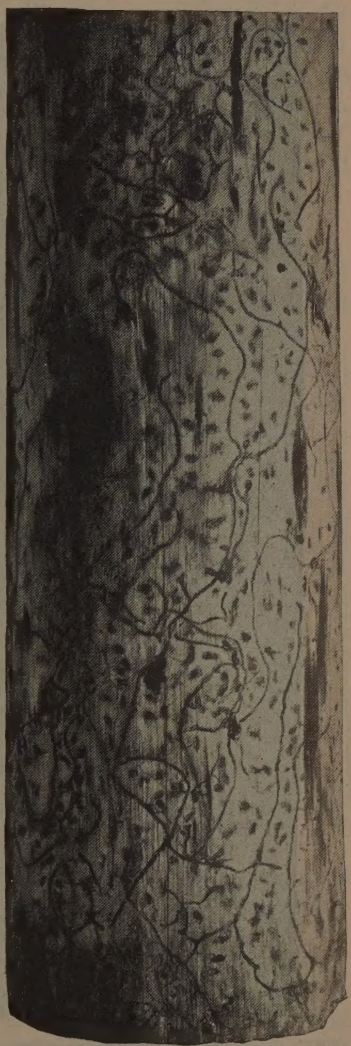

FIG. 2.—Section of pine trunk with bark removed, showing the marks of the egg galleries on the surface. (Author's illustration.)

EXTENT OF LOSSES.

Extended observations in all of the Southern States during the past 20 years lead the writer to conclude that if all of the pine that has been killed during this time by this beetle was living to-day its stumpage value would amount to from $10,000,000 to $20,000,000 or

more. Recent studies of the depredations wrought by it in the South Atlantic and Gulf States during the past three years indicate that at least $2,000,000 worth of pine has been killed. It is also evident that

FIG. 3.—Bark from pine tree showing galleries of the southern pine beetle, which kills the trees, and the larger mines of the "sawyer," which does not kill trees. (Author's illustration.)

if active steps are not taken this winter by the principal owners in the infested areas this loss will be increased to another million dollars within the next year.

THE REMEDY.

It has been determined and demonstrated that if the larger part of the infestation within an area of 8 or 10 square miles is disposed of according to the methods discovered and recommended by the experts of the Bureau of Entomology, it will bring the beetle under complete control in that area, and that thereafter control can be maintained with but slight trouble or expense. It is, therefore, evident that if the recommended methods are adopted and properly carried out the beetle can be controlled in any given community, district, county, State, or the entire South.

THE METHOD OF CONTROL.

Broadly stated, the method of control is to locate the infested trees during November, December, January, February, and March, and

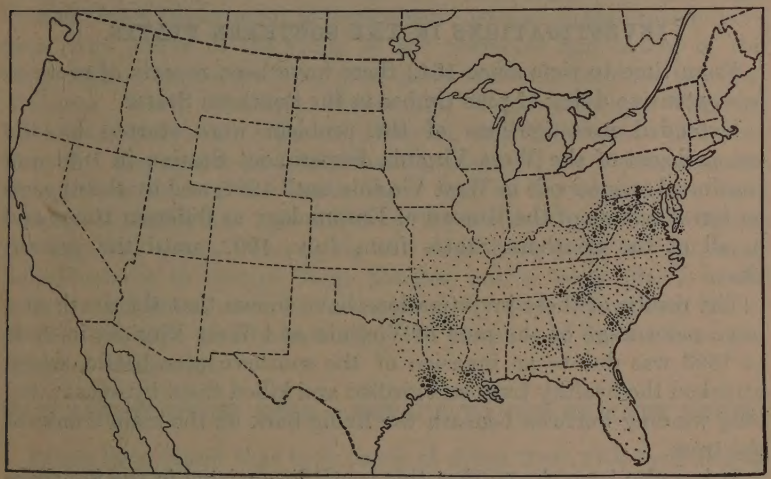

FIG. 4.—Map showing distribution of the southern pine beetle. (Author's illustration.)

destroy the overwintering broods in the bark of the main trunks, according to the recommendations on pages 13 and 14 of this bulletin.

THE COST OF CONTROL.

Experience has shown that while a large amount of timber may be dead in a given locality, it may be an accumulation of several years or months through the continued dying of the trees, so that only a comparatively few infested trees are found at any given time. Therefore, if this small number of dying and infested trees is disposed of at the proper time and in the proper manner, the cause will be removed at small cost and the dying of the pines will stop.

The cost for the required treatment will ordinarily average about 16 cents per tree.

Protecting the *living* pine of farmers' woodlots and small forests of average infested areas of 10 to 15 square miles in the central Southern States, through a direct control of the beetle, will cost from 1 to 10 cents per acre for the first year, and practically nothing thereafter for from 10 to 20 years.

The protection of the *living merchantable* pine within a similar average area will cost from 5 to 30 cents per thousand feet, board measure, or from ½ cent to 10 cents per cord for the first year and practically nothing during the next 10 to 20 years.

If the treated timber can be utilized for fuel, lumber, or any other purpose involving a commercial value, the cost will be reduced to a minimum, and in many cases a direct profit will be derived from the sale of the treated product.

INVESTIGATIONS IN THE SOUTHERN STATES.

From time to time since 1842 there have been reports of more or less extensive dying of pine timber in the Southern States.

Extended investigations of the problem were started by the entomologist of the West Virginia Experiment Station in 1891 and continued at intervals in West Virginia until 1901, and by the experts on forest insects of the Bureau of Entomology at different times and in all of the Southern States from July, 1902, until the present time.

The results of these investigations have shown that the death of a large percentage of the pine of Virginia and West Virginia in 1890 to 1893 was due to an invasion of the southern pine beetle, which attacked the healthy trees and girdled and killed them by excavating long winding burrows beneath the living bark on the main trunks of the trees.

It has also been shown that this beetle has existed in the Southern States for at least 40 years, and there is good evidence that it has occupied this region from time immemorial, but it is only at comparatively long intervals that it increases to such numbers as to cause widespread depredations.

During the summer and fall of 1910 and the winter and spring of 1911, correspondents of the Bureau of Entomology in different sections of the South, and especially in the Atlantic and Gulf States, reported that the pine was dying in patches, and that in some places the trouble was alarming. Therefore, it was made the subject of special investigation in May, June, and July, 1911, which resulted in the location of a forest insect field station at Spartanburg, S. C., for the purpose of studying the character and extent of the depredations and conducting a campaign of instruction and demonstration on the proper methods for controlling the beetle and protecting the remain-

ing living timber. This work has been prosecuted in such a manner as to convince the majority of the owners of pine within the areas covered by the representatives of the Bureau of Entomology that the southern pine beetle is a menace to the pine forests of the Southern States. There is now a general and widespread interest manifested throughout the worst affected sections, and there is every prospect that if general action is taken by the owners, in the utilization or treatment of infested trees according to the recommendations of the experts of the Bureau of Entomology, the beetles can be controlled this winter at slight expense, and that the remaining living pine will thus be protected from further depredations.

CHARACTER AND RANGE OF DEPREDATIONS DETERMINED.

Since the location of forest-insect field station 7 at Spartanburg, S. C., on July 5, 1911, the agents of the Bureau of Entomology, United States Department of Agriculture, detailed to the station have been very active in the study of the character and extent of the depredations by the southern pine beetle in South Carolina, Georgia, Alabama, North Carolina, Mississippi, Texas, Florida, Virginia, Louisiana, Maryland, Arkansas, Missouri, and Tennessee. Observations by the agents and information conveyed by correspondents from all sections of the South show that in the aggregate a vast amount of timber has been killed by the southern pine beetle during the past two years. The dying and dead trees occur as scattering individuals or in clumps, large patches, and in some places whole forests. All are more or less conspicuous by their fading, red, black, or denuded tops, plainly indicating the presence of the beetle or the progress of its work.

PATCHES OF DYING PINE A MENACE TO THE HEALTHY TREES.

It has been found that each patch of dying trees with their fading and greenish-brown tops located anywhere in the Southern States is a menace to the living pine within a radius of 3 or 4 miles. The broods of the southern pine beetle developing in the bark of the trees of one such center of infestation may swarm in any direction and settle in the healthy timber. Thus one or more additional patches is killed until nearly all of the large as well as the small pine over an extensive area is dead.

When these centers of infestation are numerous within the confines of a county, or even a larger section of territory, they can only be compared with the starting of so many forest fires, and, as has been demonstrated, they may lead to far greater destruction of merchantable pine than has ever been recorded as resulting from fire in the Southern States. Therefore they demand similar prompt and radical action on the part of the owners in order to protect their living pine.

THE MORE IMPORTANT EVIDENCES OF THE PRESENCE AND WORK OF THE BEETLE.

(1) If in clumps or patches of pine, where there is no plain evidence of serious injury by fire, the foliage fades to pale green and changes to yellowish and pale brown, it indicates that the trees are dying from the attack of the southern pine beetle, and that the bark on such trees is infested with the developing broods of minute white grubs and transforming beetles. Therefore such infested trees are a *menace to the living trees.*

(2) If the trees have reddish brown and partially fallen foliage, or if all of the foliage has fallen, it indicates that the broods of beetles have emerged and that such trees are no longer a menace to the living ones.

(3) If the trees die during the period between the 1st of March and the 1st of October, they will be abandoned by the broods of beetles within a few weeks after the foliage begins to fade.

(4) If the trees begin to die during the period between the 1st of October and the 1st of December the broods of beetles will remain in the bark until the following March or April.

HOW TO LOCATE THE INFESTED TREES.

The location of trees that are infested by the southern pine beetle is the first and one of the most important things to do before definite plans are made for the active work of cutting the trees. Some of the essential things to remember are as follows:

(1) The southern pine beetle attacks the upper and middle portions of the trunks of healthy trees.

(2) A freshly attacked tree may show pitch tubes on the trunk, reddish boring-dust around the base, or there may be no external evidence of attack until the leaves begin to fade.

(3) By the time the tops are faded and the bark on the middle and upper trunk is dead the broods of the beetles are in an advanced stage of development; yet, at the same time, the bark on the lower third of the trunk may be living and show no evidence of attack, or may be attacked by other kinds of insects which are not responsible for the death of trees.

(4) As soon as the bark begins to die on any part of the trunk it is attacked by numerous other insects, including the adults of the "sawyer" borers which do not attack healthy trees.

(5) By the time the tops have changed from pale green to greenish brown the broods of the southern pine beetle are nearly all developed to the stage when they enter the outer bark to transform to the adults.

(6) By the time the tops have changed to a reddish hue the broods have developed and are either emerging or have emerged.

(7) During the warm months the broods will develop and emerge from a tree within about 30 to 40 days after it is attacked.

(8) Trees attacked in November will usually carry the broods over winter. The foliage of some trees will fade and reach the reddish stage before spring; other trees attacked in December or later may not fade until the warm days of February, March, or April.

Therefore, in estimating the character and extent of an infestation within any given area, or in locating infested trees and marking them for utilization or treatment, one has only to consider those with fading or greenish brown foliage, or the first stage of the yellowish red tops.

ESSENTIAL DETAILS IN METHODS OF CONTROL.

There are certain essential details in the recommended methods of combating the southern pine beetle which must be observed in order to avoid not only serious mistakes but possibly ultimate failure:

(*a*) The principal clumps or patches of *dying* trees which are actually infested by the broods of the destructive beetle, as indicated by the *fading and dying* foliage, or otherwise, should be located and marked during the months of November, December, January, and February. In order to do this work, proper experience or special instruction is required. Therefore, some one who has had instructions should have charge of the work in each important area in which control work is to be undertaken.

(*b*) The *broods of the beetle* in the bark of the *main trunks* of the medium to larger sized dying infested trees within an area of 8 or 10 square miles or more must be destroyed in order to stop their depredations.

(*c*) The broods may be destroyed by *one* or *more* of the following methods, the work to be done between the 1st of November and the 1st of March:

(1) Removing and burning the infested bark from the trunks of the standing trees; or

(2) Removing and burning the infested bark from the trunks of the trees after they have been cut down; or

(3) Scorching the infested bark, or burning the wood with the bark after the trees are cut down; or

(4) Placing the infested portions of the trunks in water; or

(5) *Converting the trunks of the infested trees into cordwood and using the wood for fuel before the beetles leave the bark;* or

(6) *Converting the infested trees into lumber or other products and burning the slabs or bark.*

(*d*) It is not necessary to burn the tops or branches of treated trees or to cut and burn small infested saplings *if the larger infested trees are disposed of.*

(*e*) It is not necessary to remove or destroy the bark on the lower portion of the trunks or on the stumps if it is not infested with the destructive beetle, and it is not necessary to cut or treat dead trees from which the beetles have emerged.

(*f*) It is necessary and essential that the broods of the destructive beetle in the bark of any portion of the main trunks of the medium to larger sized dying infested trees of any given locality should be destroyed.

(*g*) If the wood of the infested trees can be utilized for fuel, lumber, or other purposes, its value should cover the cost of the work. If the work of felling and barking the trees is done at direct expense, the cost will average 10 to 30 cents per tree.

(*h*) The cost of protecting the living timber of any locality with average infestation should not exceed an average of from 1 to 5 cents per acre for the total area of pine-covered land, and if estimated on a basis of volume it should not cost over 2 cents per cord of the living timber protected.

(*i*) The best time to conduct control operations against the southern pine beetle is during the period between November 1 and March 1.

(*j*) If a pine tree standing among or near a groove or woods of living pine is either struck by lightning or felled and barked or split into cordwood during the summer and early fall, it will, as a rule, attract the beetles within a radius of 3 or 4 miles and result in the starting of a new center of infestation and in the death of a large number of trees.

(*k*) The principal owners of pine in each community should cooperate in the disposal of the required infestation but should not undertake the work until *some one or more of the owners is sufficiently familiar with the essential details of the proper methods.*

REQUIREMENTS FOR SUCCESS.

The requirements for success in any effort to protect the living pine from the destructive attacks of the southern pine beetle are the destruction of the broods of the beetle in the bark of the main trunk of the dying infested trees before they leave the bark. This is accomplished by the adoption of one or more different methods of direct utilization of the infested trunk, or treatment at direct expense in cases where the wood can not be utilized.

The attainment of the best success from the practical application of any of these methods will depend on their adaptation to local conditions and requirements for disposing of the infested timber and strict adherence to certain details which are absolutely necessary to the destruction of the broods.

The period in which to locate and mark the trees that are actually infested and in which the marked trees should be utilized or treated

to kill the broods is between the 1st of November and the 1st of March, but in some cases the period may be extended to the 1st of May.

The adoption of the method of destroying the broods which in each case is the most economical and effectual can be determined by the owners in each community if they are sufficiently informed on the essential facts.

Detailed advice, recommendations, or conclusions as to the most economical and effective method of procedure for any given area should be deferred until certain reliable information is at hand in regard to the local condition as to (*a*) the character and extent of the infestation, (*b*) the interest manifested by the people of the community in the value to them of the pine and the importance of protecting it as the source of future revenue, (*c*) the assurance of the majority of the owners that concerted action will be taken according to a definite plan and purpose, and finally, if a demonstration is desired, that local facilities will be offered for its successful prosecution.

If the owners of pine will consider the protection of their timber from the standpoint of a common interest and will realize the necessity for concerted action in the control work, success will be assured.

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